Final Report

for the

Trapped and Precipitating Electrons Experiment (F-16)

on the

Orbiting Geophysical Observatories Program

OGO-6 Mission

Contract No. NAS 5-9308

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16. Abstract

The Institute of Geophysics and Planetary Physics of the University of California built and delivered an electron spectrometer instrument for the Orbiting Geophysical Observatories program (OGO 6). This final report deals mainly with the data reduction and analysis of the experiment data.

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1.0 Introduction

The Institute of Geophysics and Planetary Physics designed, fabricated, and delivered two flight units of the particle detector instrument to TRW Systems for integration on the OGO-6 spacecraft. The spacecraft was successfully launched into polar orbit from the Western Test Range in early 1969.

This report deals mainly with the data reduction and analysis effort after launch.

2.0 Electron Spectrometer Instrument

The electron spectrometer experiment F-16 on the OGO-6 spacecraft operated continuously over the period of data acquisition from the spacecraft. The only malfunction which occurred was a sudden and permanent loss of gain of one of the seven detectors during the first hour of orbit. The cause of this malfunction could not be ascertained with certainty, but the most likely causes are (1) loss of direct contact in a connector pin, (2) opening of a weld in the detector signal line, or (3) failure of a transistor in the detector preamp. All of these conditions would be consistent with the observed failure, and none would affect the other six detectors. Fortunately, the failure occurred in one of the least important detectors. The detector viewing upward, the one viewing downward, the one viewing horizontally, and the omnidirectional detector constituted the four key detectors necessary to meet the flight objectives and none of them suffered any apparent failure or other anomaly at any time.

3.0 Data Reduction

A total of 195 magnetic tapes containing ephemeris information and somewhat more than 600 tapes containing instrument data were received. The 600 data tapes were edited, packed, and rerecorded on 100 tapes for convenience in analysis.

Primary data reduction was effected by utilizing a cathode ray tube to plot data against time. The following data plots, each on a 8-1/2 x 11 inch page, were made. Each plot series covered the entire data acquisition period.

Series 1. Four key orbital parameters -- magnetic latitude (λ), local time (LT), McIlwain coordinate (L), and magnetic field strength (B) -- were plotted against time, covering 55 minutes on each plot.

Series 2. Detector outputs were plotted against time with 55 minutes on each plot. Sheet 1 contains the upward detector flux, the downward detector flux, and the ratio of the two. Sheet 2 contains the flux from the other four detector channels and the subcommutated detector current (total energy) channel. Eight-second averages were used for all detectors.

Series 3. The orbital tapes were searched for all satellite crossings of half-integral L values between 2 and 10. At those times, the following orbital parameters were extracted: L, λ, GMT, LT, B_x, B_y, and B_z. The values of GMT were used in conjunction with the data tapes to find the electron flux for each of four detectors. CRT plots were then prepared showing the electron flux versus time at constant L for half integral values of L between 2 and 10. Each plot contains eight days on one sheet,

giving a good time history of the outer electron belt for each L value. Sheet 1 in this series contains the omniflux and horizontal flux, while sheet 2 contains the up and down flux. The B range sampled by the satellite at each L was approximately halved, and the points used on sheet 1 were either filled or unfilled according to the half in which they fell. This distinction allows the eye to avoid distraction from the longer range time trend by the variable sampling in B at a given L. Examples of all three series are included in this report.

All of the data used to construct Series 3, and all of the orbital parameters corresponding to the time of the half integral L crossings, are stored on six magnetic tapes which will be delivered to the World Data Center shortly.

4.0 Data Analysis

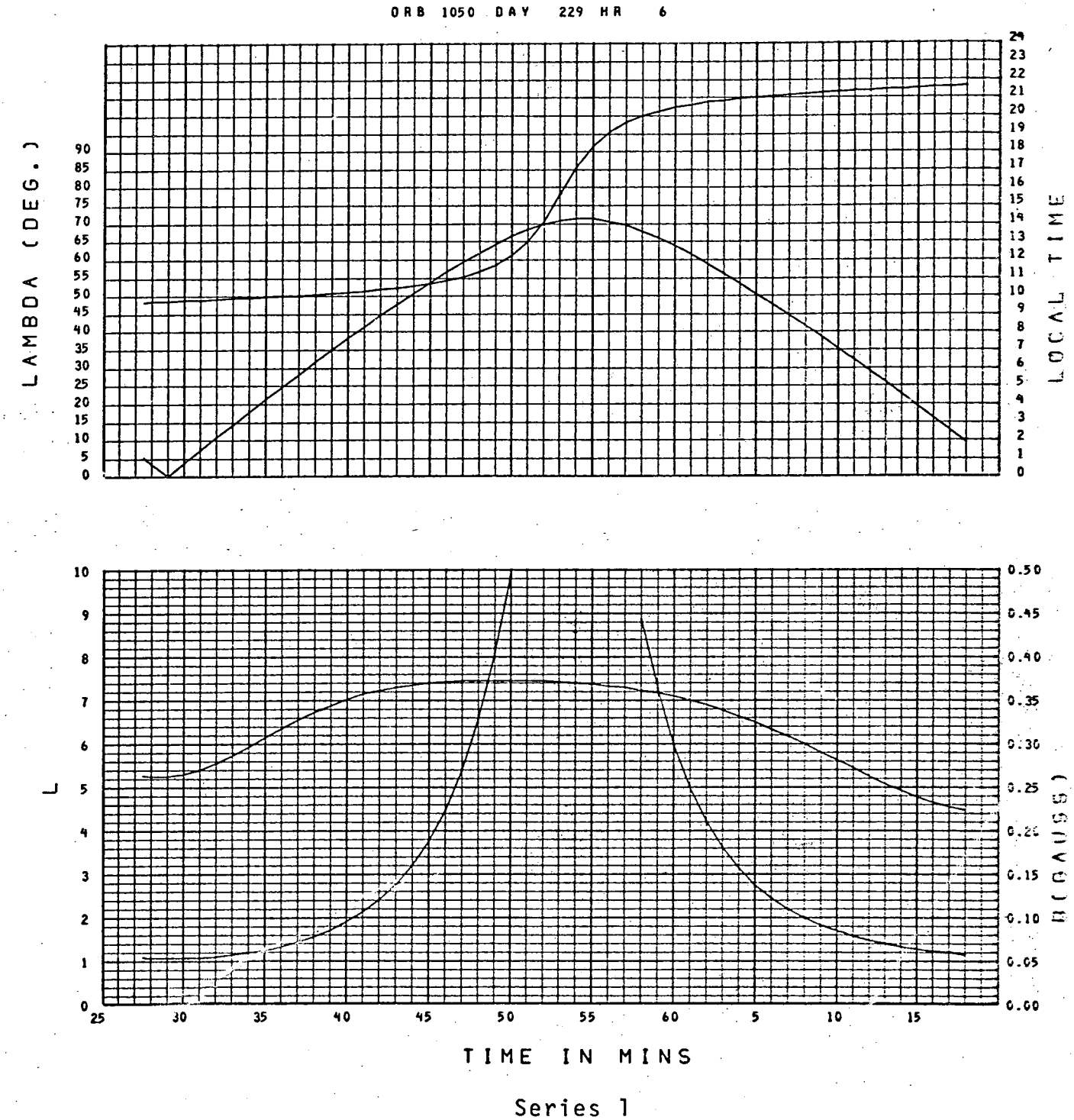
Inspection of the Series 2 plots reveals numerous precipitation events, usually heavily concentrated within periods of enhanced magnetic activity. A selection of about forty days from the period of data acquisition includes the majority of precipitation events. More than 4000 8-second intervals showing significant precipitation events have been selected from these 40 days, and Calcomp plots have been made of the data with the maximum time resolution of the spacecraft data system (approximately 0.125 sec). These individual events have been labeled by such characteristics as intensity, ratio of up flux to down flux, and (if the instrument is in energy mode) the spectral index. The 4000 events have been sorted in various ways in order to determine how these characteristics depend on such parameters as L, local time, altitude, and λ.

Two papers utilizing the data have been given at the spring meetings of the American Geophysical Union. The first of these, presented by Chapman and Farley in April 1970 at the special OGO-6 session, concerned the total energy input of >40 kev electrons into the atmosphere during a major geomagnetic storm. The second, presented by Chapman and Farley in April 1972, concerned observations which indicated that during some precipitation events the precipitated fluxes exceed the locally mirroring fluxes. Such observations have no simple explanation by mechanisms proposed to account for precipitation.

A third paper, authored by Holzer, Burton, Farley, and Chapman, was presented at the URSI meeting at UCLA in September 1971.

This paper described correlations between ELF waves and precipitated electrons, both as observed on OGO 6. The correlation supports the wave-particle cyclotron resonant interaction theory of electron precipitation.

Considerably effort has been expended since April 1972 to enlarge the data base of precipitation events in order to obtain better statistics in the analysis of these events by local time, invariant latitude, altitude, and UT. While the available data appear to form the basis for significant insights suitable for publication the study is proceeding very slowly at present, largely because very little financial support is available. How much further work can be done will depend on future availability of funds, and this cannot be readily predicted at present.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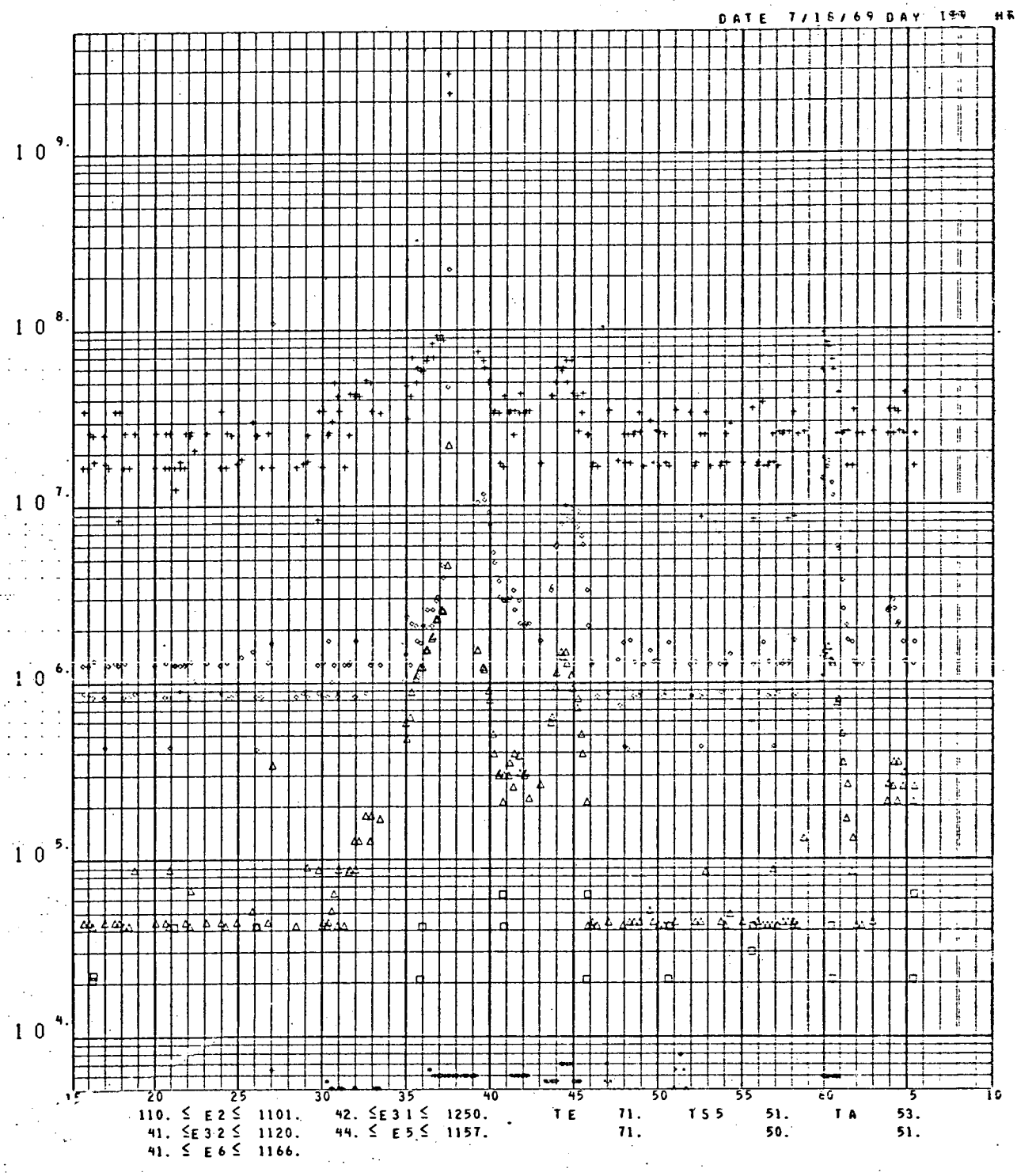
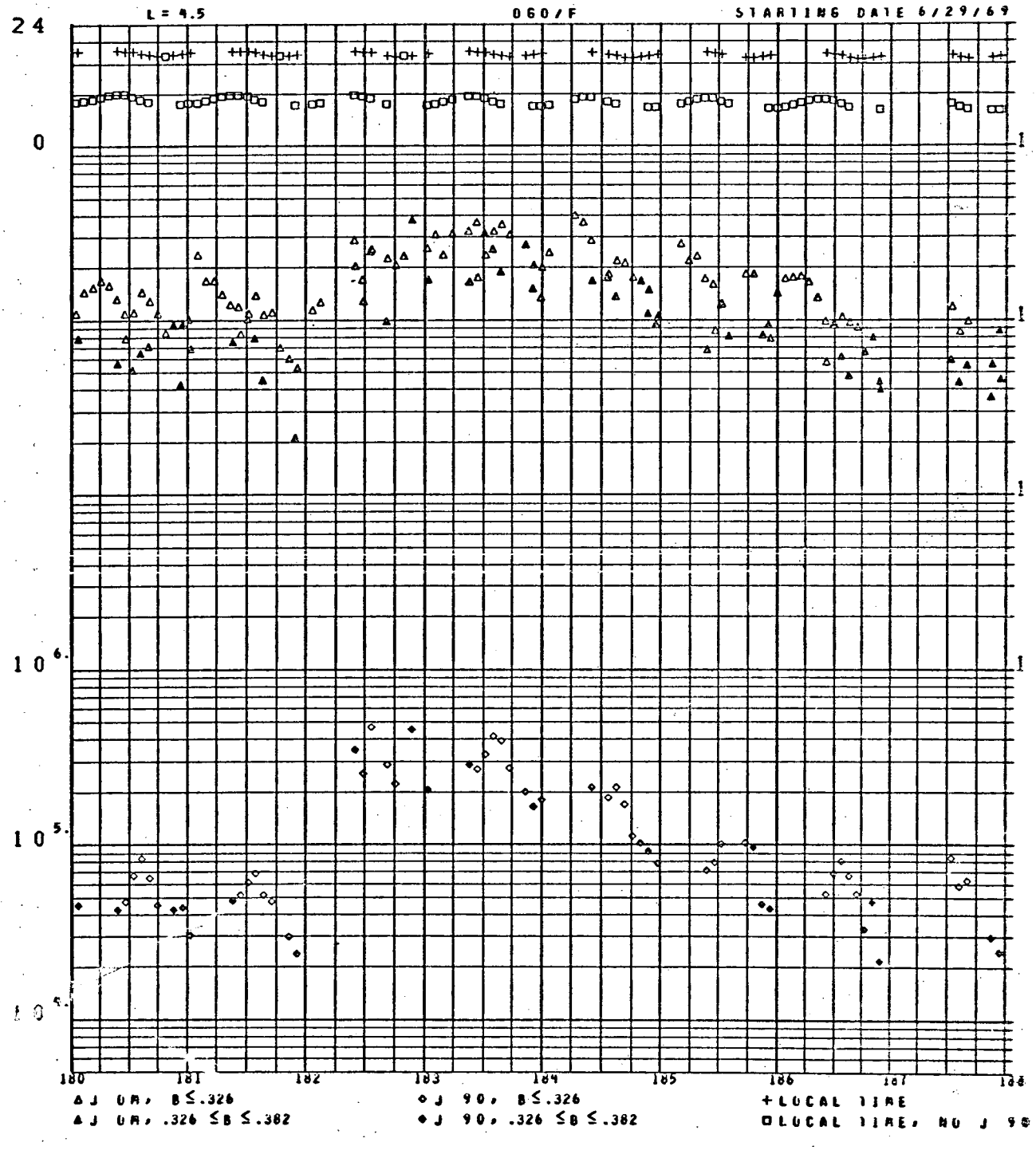
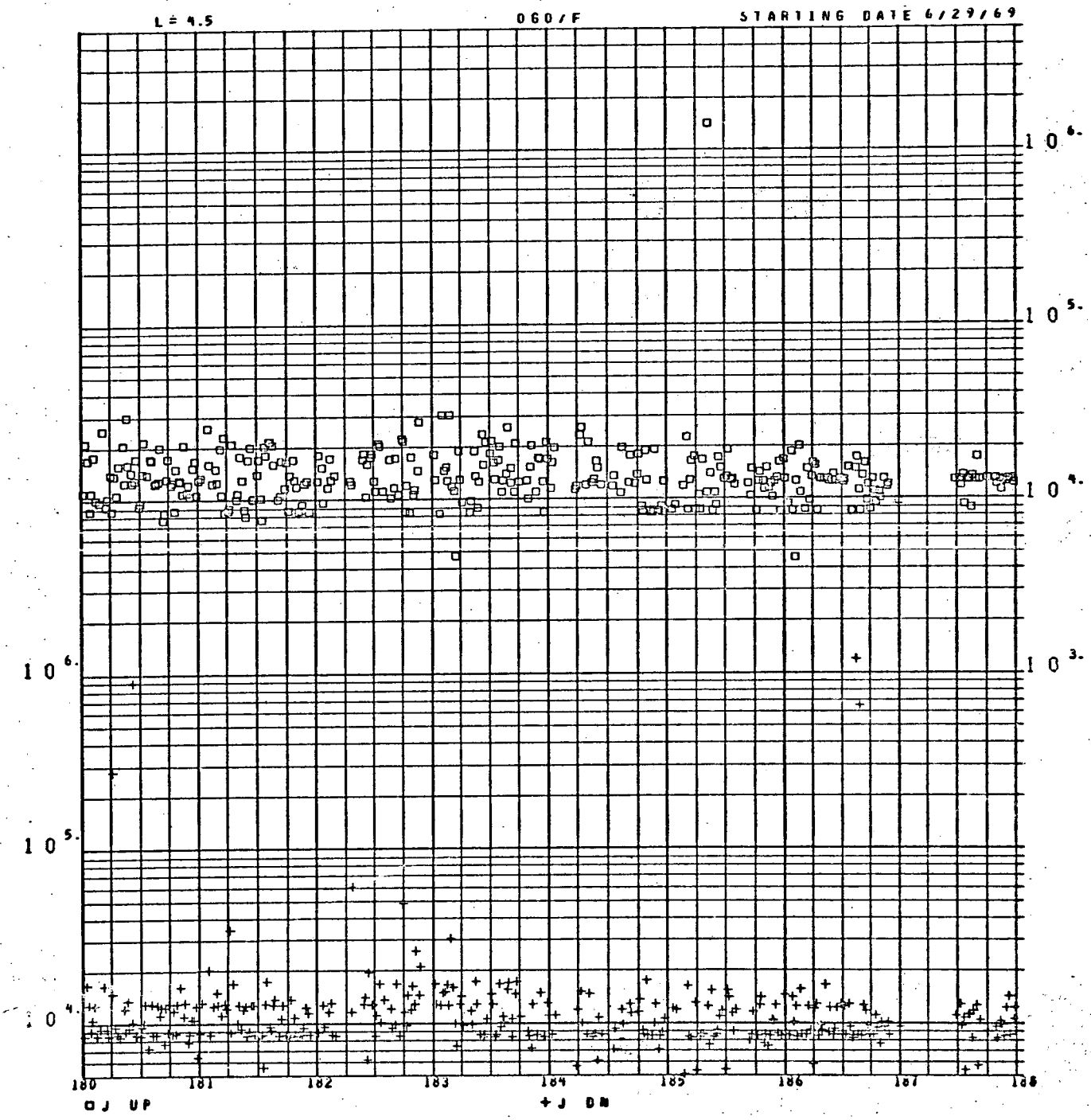
LAMBDA (DEG.)
LOCAL TIME
L
B (GAUSS)
TIME IN MINS
Series 1



Series 2, Sheet 2



Series 3, Sheet 1



Series 3, Sheet 2